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ABSTRACT

It has been suggested that in science education the immediacy and pervasiveness of television and its ability to bring the world into the classroom could be effectively used by the teacher. The motivational uses of instructional television in a high school environmental science class were studied with 57 tenth graders at a suburban high school. Units on soil and energy resources were used alternatively as control and experimental groups, with only live teacher instruction in the control condition and with televised instruction as a supplement to teacher instruction in the experimental condition. A motivation instrument used a semantic differential to measure student beliefs. Results suggest that the televised instruction did not produce significant differences in the learner's understanding, perceived value of the units, achievement test scores, or motivation. The impact of television might have been more apparent if student discussion had followed the presentations or if teacher guidance had been applied to aspects of the lessons. Eight tables present study data. (Contains 43 references.) (SLD)

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ED 370 588

The Motivational Effect of Televised Instruction on Teacher Directed Science Learning

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The Motivational Effect of Televised Instruction on Teacher Directed Science Learning

Indrani Ganguly

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Introduction

The degree to which students are motivated to learn is a major concern of those interested in improving science education. Broadly considered, motivation is the process of arousing, sustaining, and regulating activity, a concept limited to some aspect such as the energetics of behavior or purposive regulation (Elliott, 1988). The recommendation of the National Science Board Commission of Precollege Education (1983) states:

If America were to achieve world leadership in mathematics, science and technology education by 1995; two key answers to the present problem would be: ***time-on-task*** and ***motivation***.

According to the report, although the Japanese school system constructed in 1945 was closely modeled on the U.S. goal of universal education, the standard of performance of Japanese pupils has gone far ahead of their American counterparts. Japanese school systems put a high priority on mathematics and science education from the earliest grades. A typical Japanese secondary school graduate will spend about three times as many hours in science as a U.S. student who completes four years of science in high school.

The above report of the National Science Board Commission also appraised the motivational advantages that can be brought into education through the use of technological incentives. In particular, conference members were concerned that closed-circuit television, video, and other such technologies not be used to replace the classroom teacher, but to motivate students towards learning. Academic success, according to learning psychologists, depends on the degree of student motivation to learn a content area of study. This aspect of motivation becomes more compelling in science classes because many concepts of science cannot be directly shown or brought into the classroom on a daily basis. It was suggested that in science education, television's immediacy, pervasiveness, and ability to bring the world into the classroom could be effectively utilized by the teacher.

Scores on national assessments suggest the need to improve the quality of science instruction in American schools. According to the results from the 1986 NAEP Science Assessment (AAAS, 1989), there was no improvement in performance at the highest level (science proficiency scale) by any age group 9-17 year olds,

compared to the 1982 assessment. In the first International Assessment of Educational Progress (1988), 13 year olds from the U.S. and five other countries were assessed in a standardized fashion in science. Average proficiency levels fell into three groups, which were significantly different from one another. Students in the U.S. were in the lowest scoring group, well below the mean, along with Irish students and two groups of Canadian students.

In 1986 the National Assessment of Educational Progress found the average performance of 17 year olds in mathematics and science remained substantially lower than it had been in 1969 (AAAS, 1989). As a nation, enrollments in college science programs had dropped steadily. The scores of American students ranked near the bottom of the list for industrialized nations. In volume 1 of The Condition of Education (Baker, 1989), comparisons of science aptitude for the years 1977, 1982 and 1986 at five proficiency levels for 9-17 year olds revealed that only 13 and 17 year olds in 1986 showed significant changes in understanding scientific principles and applying basic information compared with that of 1977, and of 1982 respectively.

Remaining competitive in science and technology is important for the United States. The results above reveal a need for remedies for the stalemate created in science proficiencies of American pupils from 1977 to the present. It becomes all the more urgent, in the context of these results, that appropriate motivating techniques be used in the classes of American high schools when delivering science lessons.

Theoretical Base

The relationships between motivational techniques and academic achievement have been addressed by educational psychologists from a variety of approaches. From a historical point of view, theories of motivation have existed as long as people have speculated about the reasons for their own behavior. Within the last 25 years, a growing understanding has developed that human behavior is complex and is determined by many factors (Weiner, 1969). No simple explanation, such as reinforcement theory, instinct, or need can comprehensively predict the diverse patterns of structured learning.

Educational psychology continues to be the foundation for most teachers in this country in the fundamentals of learning and motivation. A significant part of the problem of understanding student motivation is that psychologists, who do most of the writing and research on theories of motivation, often disagree in their basic assumptions concerning what motivation is and how influential it can be (Schultz, 1975). There is increasing evidence according to King-Stoops, and Meier (1978) and Lufler (1978), that classroom teachers themselves identify the teachers' failure to motivate as their number one problem in discipline and control. Teachers have also expressed the need to expand and vary their motivation techniques to accommodate the increasing diversity of the classroom population.

Walberg, Schiller, and Haertel (1979) analyzed reviews of educational research in the seventies, and reported that student motivation is one of six factors that can predict cognitive, affective, and behavioral learning outcome and gains with regularity. Walberg and Uguroglu (1980) concluded that students' motivation is a necessary condition for learning. They concluded that increasing factors such as quality and amount of instruction, at great cost, will be relatively fruitless if student motivation remains at a low level. They reasoned that one of the major problems facing teachers is to find a way to systematically consolidate motivational constructs across factors (rather than a homogeneous single measure of motivation) in a manner that identifies the causal

relationship of these factors to classroom instruction.

Uguroglu and Walburg (1979) analyzed the correlation from a calibration sample of 22 students and a validation sample of 18 students. This provided evidence that motivation is consistently positively related to educational achievement. They also analyzed 232 correlations of motivation and academic learning reported in 40 cities with a combined sample size of 637,000 in grades one through 12. Ninety-eight percent of the correlations between motivation and academic achievement were positive; and the mean correlation across this sample was .34. These findings indicated that motivation had a consistent positive correlation with achievement.

There is no conclusive evidence to support the intuitive notion that motivation enhances learning, as explained in the Encyclopedia of Educational Research (1969). Part of the problem is that so many variables affect learning that it is difficult to isolate motivation and understand its true impact. Student motivation can be viewed as a function of ***expectancy of success*** and ***perceived value*** (Schunk, 1991). Instructors can directly maintain or increase student motivation by maximizing student expectations to succeed and increasing the perceived value which students assign to the course goals and objectives.

In a recent study (Nohen, & Haladyna, 1990) the beliefs of high school science students about the usefulness of various study strategies and their relationship to motivational orientations, perceived ability and attitude toward science were addressed. The results showed that such beliefs were more positively related to task orientations (one of the three categories of the motivation scale). Zeidner (1987) found that student motivation and attitude towards varying test formats (i.e. multiple-choice vs essay) could be assessed using a 10-item likert type scale with a five point continuum. Craig (1988) suggested that ability attributions for high school success have a positive effect on expectancy of success in college and on academic self concept. Effort attributions positively affect both academic self concept and predicted effort in college. This is consistent with Weiner's theory (1980) of expectancy--value approach to achievement motivation.

Since research in educational psychology has demonstrated that what teachers do is significantly related to student motivation, it is worthwhile to examine what technical means teachers can use to facilitate motivation (Wlodkowski, 1982). Television is one such technological incentive that influences elements of the affective domain such as interest, emotion or motivation. W. Gray (cited in Martin & Briggs, 1986), a psychiatrist, proposed that emotional nuances are the organizing structure for thought and knowledge, with cognitive structures having a much less important role to play. With regard to learning and education, Gray suggested that ignoring feelings may actually retard efficiency in learning.

The power of television to impact on student motivation, interest and attention is evidenced by the 1980 review of relevant research on the effects of the content of entertainment on television (Milavsky, Kessler, Stipp, & Rubens, 1982). One conclusion in the resulting report was that viewing by children of violence on television increased aggressive behavior. Although, this conclusion was challenged by the television networks, the convergence of evidence from many studies is overwhelming that television violence does lead to increased violence in children (Rubenstein, 1983).

Television can also be used to provide or supplement instruction within the

school. Conclusions about the efficacy of instructional television have been mixed. This may be due, in part, to lack of availability of compatible equipments, state-wide distribution systems, appropriate programs for specific curriculum areas, and consortium mode for production. Despite these handicaps, about one-third of the nation's students use instructional television on a regular basis (Rockman, 1985). Over the last twenty years, national regional agencies reviewed the availability of local materials, and the users of ITV identified various benefits, e.g., ITV increased motivation, illustrated difficult-to-teach concepts, and provided a common stimulus from which the teacher could teach.

Whether television programs have any impact in the affective domain on a learner has been studied from various standpoints. One major point studied in this regard is the instructional design of the program. Wakshlag (1982), Watts & Bentley (1987, 1988) ascribed the power of ITV to motivate learners to its design. Some typical responses of specific pupils were reported by the researchers. The best programs were entertaining, used contemporary media techniques and focused on social implications of science. Both teachers and pupils preferred the programs to be explanatory rather than simply descriptive. The teachers viewed educational television as an aid to teaching rather than learning. Youngsters valued the visual images and preferred the programs to be contextualized in the everyday experiences with which they were familiar. The use of background music at a certain tempo made a definite impact on the attention of the learners. It was found that irrespective of appeal, fast background music impeded information acquisition. The researchers concluded that if music was used intermittently and with high frequency or in combination with gratifiers such as humor, both attention and information acquisition would be facilitated.

A very comprehensive report based on over 50 formative research studies on the new PBS series 3-2-1 Contact was used for the development of the series to motivate children's interest in science and technology (Chen, 1980). The study generated many insights for program development in order to motivate students. Among them were strong storyline, active visuals, and the use of appropriate humor.

However, the above objectives of formative research tell us very little about the actual role the product can play in the ongoing environment of the classroom. Situated research serves a different purpose, that of effectively integrating technologies into teaching and learning. This type of research addresses questions concerning how the educational technology functions within the complex environment of the classroom (Hawkins & Honey, 1990).

The question of how well television teaches is likely to become increasingly important as the educational and tutorial role of the medium expands. O'Loughlin & White (1982), concluded from their research that the direct instructional model of ITV programs had a significant effect on children's learning. Direct instruction is a multi-faceted concept which includes a specification of desirable classroom management techniques as well as appropriate procedure for the effective presentation of information.

Several studies have been conducted to assess positive effects of TV on the attendance, scores, and attitudes of students. Studies (Wen, 1989; Ritchie & Newby, 1989) have shown that attendance was significantly higher in the language laboratory using TV as the supplementary medium. Also students using TV evaluated the instructor significantly higher than students not using such a medium. The test information indicated that there was significant increase in aural comprehension, reading comprehension and grammar

abilities by the experimental group using TV as a supplementary medium. More importantly, those who had better attendance and attitudes also showed greater comparative improvement in their posttest scores. In the multiple group comparison, viz. traditional, studio, and distance learning, student attitude was more positive if the potential for interaction were present.

Whether television programs have the power to draw attention and arouse above or below average middle school boys and girls was investigated in a 1990 study. Results confirmed that an interaction between gender and ability differences in GSR (a measure of autonomic arousal) occurred for 5th and 6th graders while watching science educational television program.

Cognitive and motivational theory suggest that learner's schemata and attributions may influence their preconceptions of a medium (Weiner, 1979). Salomon (1984) arrived at the conclusion that previous social cues surrounding the viewing of television affect the Amount of Invested Mental Effort (AIME) in a negative way; that is people invest less effort in processing information from television and apparently learn less from it because it is perceived to be "easy". The characteristics of the medium can be manipulated easily in order to alter the learner's preconceptions of a mediated lesson and increase the mental effort that learners invest in processing the lesson. Cennamo et al. (1990) investigated learner's preconceptions of interactive video (IV), instructional television (ITV), and television (TV), and compared the three treatment groups on learner's perceptions of invested mental effort and achievement on a test of recall and inference. The results indicated that learners who were required to actively respond to practice questions that were embedded in a video based lesson recalled significantly more information than learners who were not provided with practice questions.

Methodology and Research Design

Against the above background of information on past research, measuring motivation through technological incentive like instructional television in high school science learning would be useful. This study investigated the motivational prowess of Instructional Television (ITV) used in a high school environmental science class. Instructional television (ITV) is characterized as closed-circuit video-taped or video-disc programs which are designed primarily to instruct rather than entertain. Educational television (ETV) programs have the dual purposes of instruction and entertainment.

Subjects

The sample for this study was tenth grade students of a suburban school near Cincinnati. The school had an enrollment of 1,987 students in grades 9 through 12. There were 110 teachers teaching at various levels. The school owned 2 to 5 VCR units and 67 units of microcomputers, namely, Apple, IBM, and Macintosh, 16mm films, and 500 video tapes. The student body was made up of 1% Asian, 4% Black and 95% white students. For the school district, in an average daily membership of 10,236 students, the majority are white students forming 89.7% of the population. The next are black students making 8.8% of the population, followed by Asian/Oriental 1.0%, and Hispanic 0.3%.

Research Design

Students in two tenth grade sections were enrolled in environmental science. The two sections enrolled a total of 57 students. Research data were collected during the teaching of two text book units: Soil and Energy Resources. The two sections were used alternately as the control and the experimental group for the two

units. When serving as the control group, the class received the live teacher instruction alone. When serving as the experimental group, the class received televised instruction as a supplement to live teacher instruction. At the end of each unit the teacher gave the usual unit test. During the unit, students in the experimental group were shown appropriate video tapes at two different points. The purpose of the tapes was to improve student motivation toward the topic. The five tapes used were: Soil from the beginning (11 mins.), Common ground:Farming and wildlife (60 mins), Energy in perspective (21 mins), Nuclear energy (10 mins), and Future energy resources (15 mins). These were selected by the teacher from the school media library, and subsequently previewed by him for use in the classroom.

A quasi-experimental, intact group, crossover design was employed. The researcher observed the classes on six days during the teaching of the units. For each unit, the classes were observed for three days. Two of these days, included the two televised instruction days and one traditional teaching day for the experimental group. The student engagement rate was measured by the researcher on each day of observation. The class time available was 50 minutes. Every 5 minutes students were observed in order to judge whether they were engaged in learning, uninvolved, socializing, or waiting for the time to pass. The students were thus observed 10 times. Across these 10 observations, if a student was uninvolved 0-2 times, the involvement was regarded as "high", if uninvolved 3-5 times, the involvement was regarded as "moderate", and if so between 6-10 times, then it was regarded as "low" involvement. These data are shown and analyzed in the section on student involvement.

The unit tests on the Soil and Energy Resources were given by the teacher at the completion of each unit. The instrument for measuring motivation (will be available upon request) prepared by the researcher used two dimensions: expectancy of success and perceived value. This instrument was given to the students after they had completed both units. The reliabilities of the instrument for measuring motivation are reported in Table I.

The motivation instrument used a "semantic differential" to measure the beliefs that the respondent holds about each topic. Alpha reliability is the measure of internal consistency. The source of this instrument is Osgood's evaluation factors. The motivation tests given on the soil unit and the energy unit were judged to have face validity and construct validity based upon previous work by Osgood (1957).

Results

Summary of qualitative observations

The researcher found that the students of the two classes were similar in their behavior, attention span, interest, and seriousness in learning. It appeared that the same students maintained a more serious attitude toward studies while others were casual. Some boys seemed to be more interested in learning than the girls. The students who socialized during class, did so for all classes irrespective of the topic or the activities. At least two students out of 25, in each class, slept throughout the period on all days of observation. On the whole, the involvement of the students shown toward their studies was at a low level. A couple of students engaged in other activities during the period on two occasions. The teacher had a friendly attitude toward the students in general, but warned the students found sleeping in class/or being inattentive, three times during the six days. The use of the televised program on the soil unit for the entire duration of the period on the third day of observation was not expected by the researcher. It was expected that televised

instruction was to supplement live teacher instruction. The above mode of using the videotape altered the nature of the treatment originally proposed, as that of teacher-media partnership. The teacher did not quite attempt to integrate the information of the televised program with the body of his lesson in a consistent manner. As a result the purpose of showing the programs was somewhat lost, as the teacher's message and that of the television remained isolated for the most part.

Data Analysis

Table I
Test Reliability Estimates

Test of Motivation	Alpha coefficient
Energy Total	**.76**
Energy	.61
Energy Value	.74
Soil Total	**.73**
Soil Understanding	.63
Soil Value	.77

Equivalence of samples. The study was designed to test whether televised instruction made any difference in the measures of motivation of the students of environmental science class. Since subjects were in intact groups it was necessary to ensure whether the control and experimental groups were equivalent. Table II describes the performance of subject populations on the Student Ability Index (SAI) and science grade point average (GPA) for the last quarter.

These results show that the groups did not differ on either the SAI or the science GPA for the last quarter, since the difference in the means was not statistically significant.

A MANOVA was done to test whether the groups were different on SAI and science GPA simultaneously. The significance of F being .916, there was no difference between the groups on SAI and science GPA.

Finally, according to the teacher's estimate, the two groups were equivalent on their level of aptitude and performance. Based upon these observations, the control and experimental groups were deemed equivalent.

Treatment Effect. The study was done to examine whether the treatment had an effect on the students' achievement and motivation (See Table III). For the soil unit, students in section 1 were the experimental group and for the energy unit, students in section 2 were the experimental group.

Table II
SAI and Science Grade Point Average of Subject Populations

	Section	Mean	SD	N
SAI				
	1	108.7	8.75	19
	2	107.5	10.94	24
Science GPA	(4 point scale)			
	1	2.34	1.01	29
	2	2.14	1.18	28

Table III
Descriptive Analysis of Treatment Effect

	Treatment			Control		
Soil	**X**	**SD**	**N**	**X**	**SD**	**N**
Motivation	4.57	2.73	28	4.49	2.4	24
Understanding	-1.1	3.08	28	-1.2	2.7	24
Value	-1.4	4.05	28	-.70	4.18	24
Achievement	50.4	9.8	28	48.8	12.7	28
	Control			**Treatment**		
Energy	**X**	**SD**	**N**	**X**	**SD**	**N**
Motivation	5.71	2.96	28	6.90	2.38	23
Understanding	-2.1	3.03	28	-2.3	3.72	24
Value	-3.3	4.19	28	-4.1	4.34	23
Achievement	48.9	7.66	29	50.3	12.9	24

A MANCOVA (Wilks test) was done to test for differences between the groups on soil understanding, soil value, and soil achievement when science GPA was used as a covariate. The significance of F .000 shows that the covariate "science GPA" was related with at least one of the three dependent variables:
soil understanding, soil value, and soil achievement. The results of the univariate tests are shown in Table IV.

The univariate test revealed that each of the three variables was related to previous science grade. A MANCOVA (Wilks test) obtained a significance of F .000, which shows that the covariate "science GPA" was related with at least one of the three dependent variables: energy understanding, energy value, and energy achievement. The results of the univariate tests are shown in Table V.

The univariate results showed that only energy understanding was related to previous science grade.

A MANOVA (Wilks test) on energy motivation and achievement with science GPA as the covariate yielded the significance of F 0.132 suggests there was no significant difference between the two groups on energy motivation and energy achievement.

A MANOVA (Wilks test) on soil motivation and achievement with science GPA as the covariate yielded the

Table IV
Univariate Test

Variable	Sq	Mul. R	Adj	Hyp	Error	F	Sig of
Soil Understanding	.16250	.40312	.1450	68.3	7.33	9.31	.004
Soil Value	.07748	.27835	.0582	64.4	15.9	4.03	.050
Soil Achievement	.33171	.57594	.3177	22.20	93.2	23.8	.000

Table V
Univariate Test

Variable	Sq	Mul R	Adj	Hyp	Erro	F	Sig
Energy Understand.	.43281	.65788	.42048	21.3	60.77	35.1	.000
Energy Value	.03782	.19448	.01691	32.2	17.82	1.80	.185
Energy Achievement	.04211	.20520	.02128	21.5	10.64	2.02	.162

significance F 0.998 suggests that there was no significant difference between the groups on soil motivation and soil achievement.

Student engagement. The involvement of the students in the two groups was rated by the researcher as described in the methodology section and was analyzed by chi-square method. The null hypothesis was that the groups would be equivalent on involvement rate for the two units. Tables VI and VII show the involvement level of students for the two units of soil and energy resources, respectively.

Table VI
Student Engagement Rate: Soil Unit

Day	Involvement	Control	Experimental
1	High	11	6
	Moderate	0	6
	Low	12	13
2	High	5	16
	Moderate	15	7
	Low	5	4
3	High	11	16
	Moderate	8	5
	Low	8	5

The chi-square value was 2.530 with 2 degrees of freedom, which was less than the critical value of 5.99 at .05 level. Hence we fail to reject the null hypothesis and we report that the groups were same on involvement for the soil unit.

Table VII
Student Engagement Rate: Energy Unit

Day	Involvement	Control	Experimental
4	High	17	17
	Moderate	4	2
	Low	2	7
5	High	15	11
	Moderate	4	5
	Low	8	4
6	High	14	15
	Moderate	4	4
	Low	8	9

The chi-square value was .151 with 2 degrees of freedom, which was less than the critical value of 5.99 at .05 level. The null hypothesis was not rejected. Hence the groups are same on involvement for the Energy Unit.

On the basis of the above information the involvement of the students across units was analyzed using the chi square method. The results are reported in Table VIII.

The chi-square value on the above table was 10.206, which is greater than the critical value of 5.99. Hence the students' involvement was significantly different for the two units of soil and energy. Involvement was higher for the energy resources unit. Fifty-nine percent of the students exhibited high involvement levels during the energy unit as opposed to 42.4% during the soil unit.

Table VIII
Student Involvement Across Units

Involvement	Energy	Soil	Total
High	89	65	154
Moderate	23	41	64
Low	38	47	85

Conclusions and Discussion

The results of the study suggest that televised instruction used as a support to live teacher instruction did not produce significant differences in the learner's understanding, the perceived value of the units, achievement test scores, or motivation. The study had several limitations. The first was that the content and use of the videotapes might not have been appropriate to motivate students. The second tape on soil dwelled on food production and agriculture and did not relate directly to the contents of the unit. The use of the televised program for the duration of the period was not deemed appropriate by the researcher since there was no follow up discussion or activity. The main defect in the presentation of the tapes was that the content of the tapes was not referred to by the teacher at the end of the viewing. As a result, the televised program stood in isolation and the students did not have the opportunity to discuss what they viewed.

Television has the potential to present science in a certain context, enabling learners to become immersed in the culture of an academic domain. Situated cognition takes place in learners at their individual levels through perceptual learning. Since perception is both fact as well as non-fact, teachers need to "tune the attention" of students to those aspects of the situation that will afford the acquisition of the intended knowledge. Next, teachers must provide "scaffolding" for novices which will initially limit their access to all the complexities of the context but later be removed as students upgrade to expert performance (Young, 1993). In this study, the teacher did not provide such guidance.

Since this is a situated research, it may serve to guide future researchers in utilizing the potential of television in motivating students for learning science.

This researcher believes the results of this study could be improved by:

1. Selecting better televised programs that would relate more closely with the content.
2. Integrating the televised instruction with the lesson flow so as to allow the students to see the connection.
3. Extending the research over a longer period of time, say over two months.

Good quality visuals on the television monitor supported by a clear commentary may have the potential to encourage students to appreciate the nature of science and leave a permanent impression on the mind. Exploiting the potential of television may add a new dimension to our instructional process. Motivating students to learn is a constant challenge for every teacher and televised instruction could make our effort a lot more easier if the above suggestions could be implemented.

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